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United States Patent [19]

Siems et al.

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[54] **ENGINE WIRING SYSTEM**

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[73] Assignee: **Caterpillar Inc.**, Peoria, Ill.

[21] Appl. No.: **316,972**

[22] Filed: **Oct. 3, 1994**

[51] **Int. Cl.**[6] **H01R 3/00**

[52] **U.S. Cl.** **439/491**; 439/932

[58] **Field of Search** 439/34, 35, 130, 439/488, 491, 932, 495, 497, 498, 502, 503, 623

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[57] **ABSTRACT**

A wiring system for use with an engine or power module having a number of electrical systems includes a first electrical device of an electrical system, a second electrical device of the electrical system, and an electrical connector connected between the first and the second electrical devices to define an electrical circuit. The electrical connector includes alpha-numeric indicia identifying the electrical circuit. The alpha-numeric indicia include a first alpha-numeric indicium corresponding to the electrical system, a second alpha-numeric indicium corresponding to the first electrical device and a third alpha-numeric indicium corresponding to the second electrical device. The wiring system can also include a connection terminal disposed between the first and second electrical devices, wherein the electrical connector includes both first alpha-numeric indicia identifying the electrical circuit and second alpha-numeric identifying the connection terminal.

20 Claims, 4 Drawing Sheets

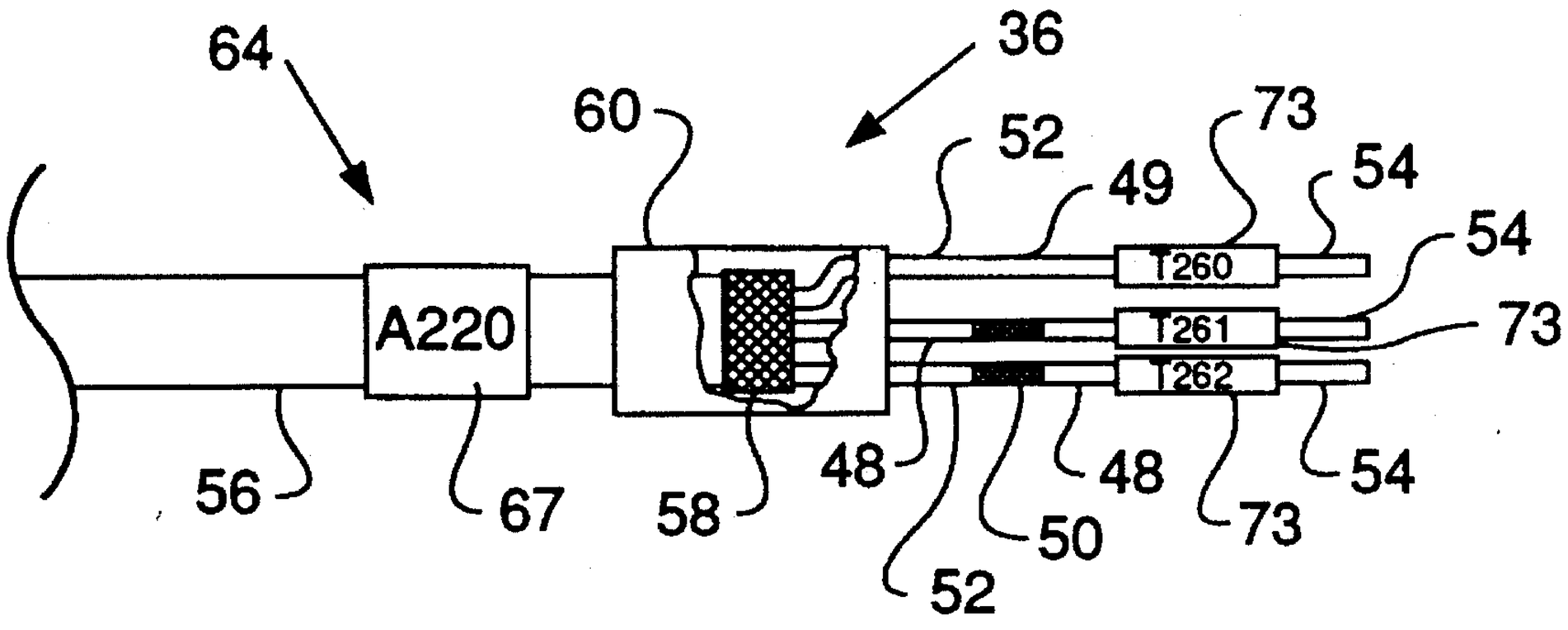

FIG-1

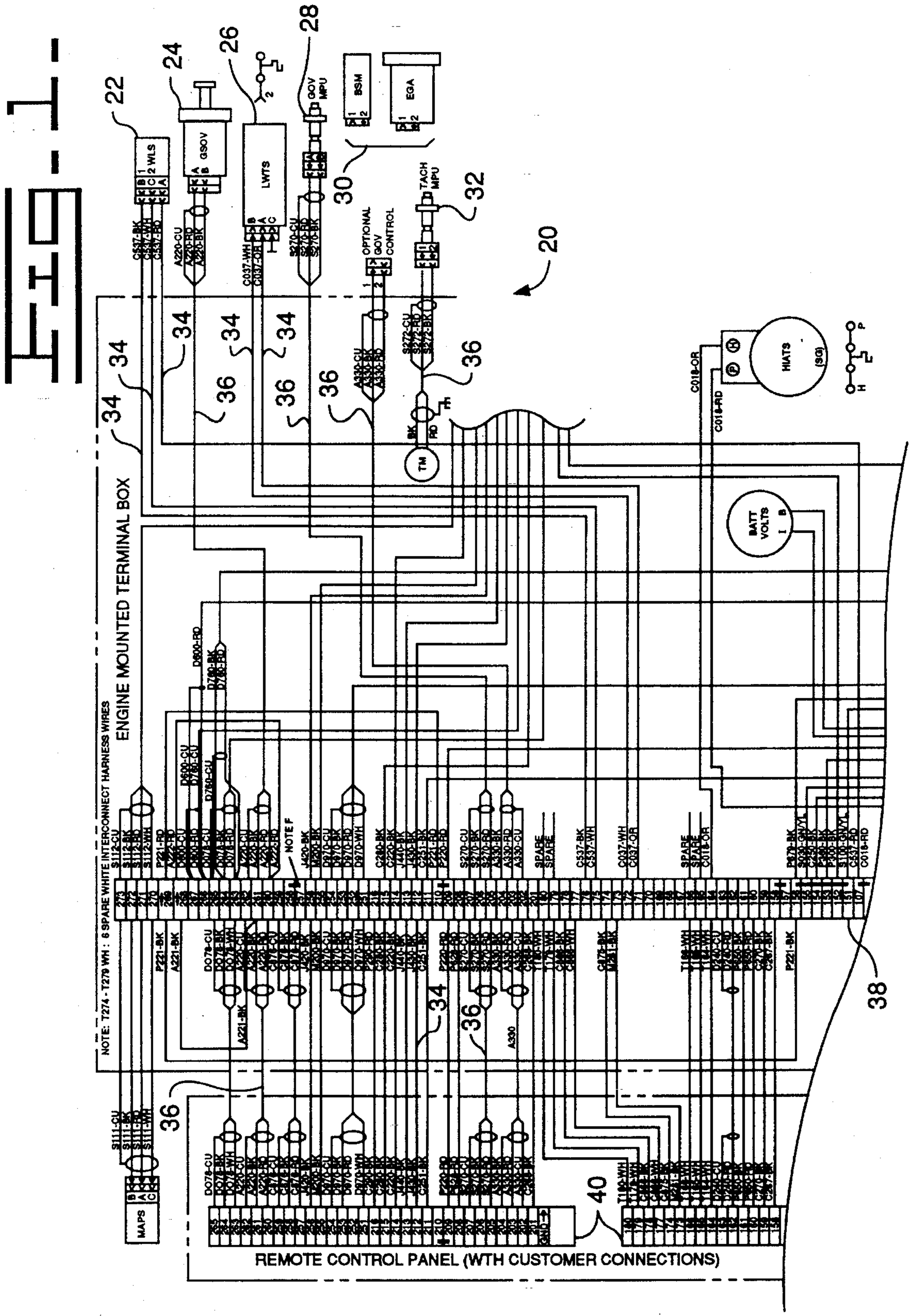
20
22
24
26
28
30
32
34
36
38
40
GOV MPU
BSM
EGA
TACH MPU
OPTIONAL GOV CONTROL
LWTS
GSOV
2 WLS
HIATS
BATT VOLTS
TM
MAPS
ENGINE MOUNTED TERMINAL BOX
REMOTE CONTROL PANEL (WTH CUSTOMER CONNECTIONS)
NOTE: T274 - T279 WH : 6 SPARE WHITE INTERCONNECT HARNESS WIRES
NOTE F
SPARE

FIG. 2

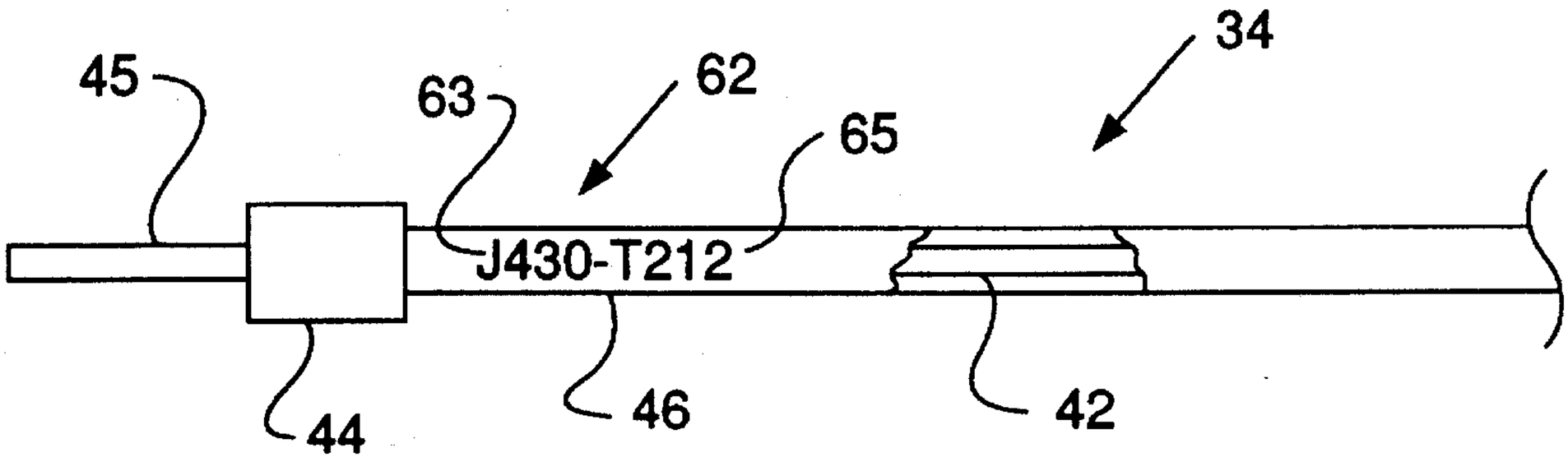
45
63
62
65
34
J430-T212
44
46
42

FIG. 3

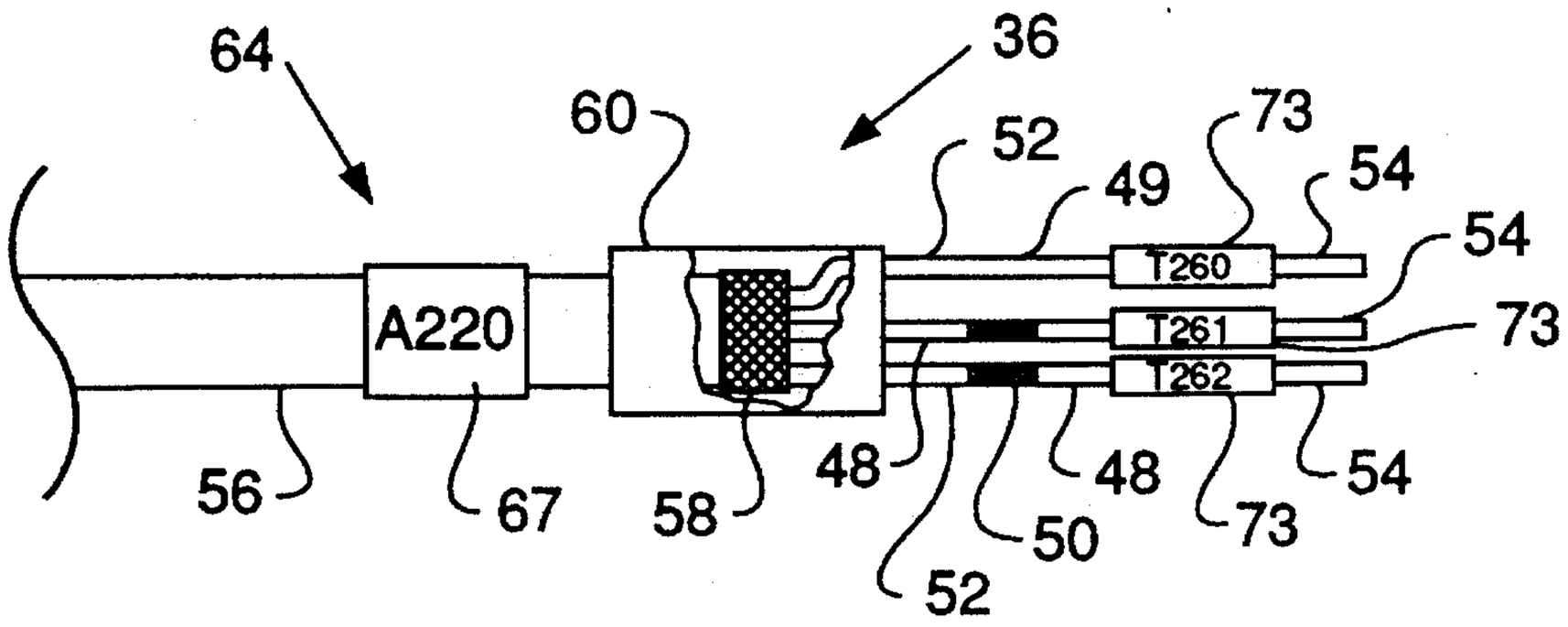
64
60
36
52
49
73
54
54
T260
T261
T262
73
A220
56
67
58
48
48
54
73
50
52

FIG_4_

TYPE OF DEVICE

J	IGNITION SYSTEM

69 70 71 68

0	CYLINDER 1-9	X	2ND DIGIT CYLINDER NUMBER (0-9)	1	COIL POSITIVE
1	CYLINDER 10-16			2	COIL POSITIVE
				TO DISTINGUISH BETWEEN DEVICES WITH IDENTICAL CODES	
2	MAGNETO	0	CASE GROUND	0	DEVICE NO. 1
3	MAGNETO INTERFACE BOX	1	ALARM SIGNAL	1	DEVICE NO. 2
4	ELECTRONIC IGNITION SYSTEM	2	SHUTDOWN SIGNAL	2	DEVICE NO. 3
5	OVERSPEED SWITCH	3	ALARM INDICATOR	3	DEVICE NO. 4
6	MAGNETIC SWITCH (MURPHY)	4	SHUTDOWN INDICATOR	4	DEVICE NO. 5
7		5	OVERSPEED SWITCH	5	DEVICE NO. 6
8		6	MAGNETIC SWITCH (MURPHY)	6	DEVICE NO. 7
9	MISC	7	GROUND	7	DEVICE NO. 8
A		8		8	DEVICE NO. 9
Z		9	MISC	9	MISC

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P POWER

SOURCE		SOURCE 2		TO DISTINGUISH BETWEEN DEVICES WITH IDENTICAL CODES	
0	ALTERNATOR	0	ELECTRONIC IGNITION CONTROL	0	DEVICE NO. 1
1	BATTERY UNFUSED (+)	1	TIMING CONTROL	1	DEVICE NO. 2
2	BATTERY FUSED (+)	2	STATUS CONTROL	2	STOP
3	BATTERY NEGATIVE (-)	3	ENGINE CONTROL #1 GOV	3	OFF/RESET
4	CONDITIONED POWER (+)	4	ENGINE CONTROL #2	4	AUTO
5	CONDITIONED POWER (-)	5	ENGINE CONTROL #3	5	MANUAL
6	SWITCHED POWER	6	DDTC/DISPLAY MODULE	6	DDTC/DISPLAY MODULE
7	BATTERY CHARGER	7	TERMINAL BOX	7	TERMINAL BOX
8	AMMETER	8	CONTROL PANEL	8	CONTROL PANEL
9	MISC	9	POWER DISTRIBUTION BOX	9	INDICATOR LAMP
A		A	ACTUATOR	A	DEVICE 3-10
Z		B	STARTING MOTOR	Z	MISC
		C	ALTERNATOR		
		D	AMMETER/VOLTMETER		
		E	CIRCUIT BREAKER		

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D DATA LINK

SOURCE 1		DESTINATION		TO DISTINGUISH BETWEEN DEVICES WITH IDENTICAL CODES	
0	ELECTRONIC IGNITION CONTROL	0	ELECTRONIC IGNITION CONTROL	0	DEVICE NO. 1
1	TIMING CONTROL	1	TIMING CONTROL	1	DEVICE NO. 2
2	STATUS CONTROL	2	STATUS CONTROL	2	DEVICE NO. 3
3	ENGINE CONTROL #1 GOV	3	ENGINE CONTROL #1 GOV	3	DEVICE NO. 4
4	ENGINE CONTROL #2	4	ENGINE CONTROL #2	4	DEVICE NO. 5
5	ENGINE CONTROL #3	5	ENGINE CONTROL #3	5	DEVICE NO. 6
6	DDTC/DISPLAY MODULE	6	DDTC/DISPLAY MODULE	6	DEVICE NO. 7
7	TERMINAL BOX	7	TERMINAL BOX	7	TERMINAL/SPLICE
8	CONTROL PANEL	8	CATERPILLAR DATA LINK	8	CATERPILLAR DATA LINK
9	MISC	9	RS 232	9	RS 232
A		A	MISC	A	MISC
Z		Z		Z	

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M MODULE

1ST MODULE		2ND MODULE		TO DISTINGUISH BETWEEN DEVICES WITH IDENTICAL CODES	
0	ELECTRONIC IGNITION CONTROL	0	ELECTRONIC IGNITION CONTROL	0	DEVICE NO. 1
1	TIMING CONTROL	1	TIMING CONTROL	1	DEVICE NO. 2
2	STATUS CONTROL	2	STATUS CONTROL	2	DEVICE NO. 3
3	ENGINE CONTROL #1 GOV	3	ENGINE CONTROL #1 GOV	3	DEVICE NO. 4
4	ENGINE CONTROL #2	4	ENGINE CONTROL #2	4	DEVICE NO. 5
5	ENGINE CONTROL #3	5	ENGINE CONTROL #3	5	DEVICE NO. 6
6	DDTC/DISPLAY MODULE	6	DDTC/DISPLAY MODULE	6	DEVICE NO. 7
7	SPEED	7	UNUSED	7	DEVICE NO. 8
8	UNUSED	8	TERMINAL STRIP	8	DEVICE NO. 9
9	MISC	9	MISC	9	MISC
A		A		A	
Z		Z		Z	

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79 80 81

A ACTUATOR

SOURCE OF CONTROL		CONTROLLED PARAMETER		TO DISTINGUISH BETWEEN DEVICES WITH IDENTICAL CODES	
0	ELECTRONIC IGNITION CONTROL	0	UNUSED	0	DEVICE NO. 1
1	TIMING CONTROL	1	AIR	1	DEVICE NO. 2
2	STATUS CONTROL	2	FUEL	2	DEVICE NO. 3
3	ENGINE CONTROL #1 GOV	3	GOVERNOR/SPEED	3	DEVICE NO. 4
4	ENGINE CONTROL #2	4		4	DEVICE NO. 5
5	ENGINE CONTROL #3	5		5	DEVICE NO. 6
6	ACTUATOR	6		6	DEVICE NO. 7
7	UNUSED	7		7	DEVICE NO. 8
8	UNUSED	8		8	DEVICE NO. 9
9	MISC	9	MISC	9	MISC
A		A		A	
Z		Z		Z	

Fig_5_

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EIS REMOTE CONTROL PANEL				
CIRCUIT IDENT	DESCRIPTION	TERMINATION	COLOR IDENT	TERMINATION
A220-T260	GAS SHUTOFF VALVE	TERMINAL STRIP 260	RD	ESCM - 23
A220-T261	GAS SHUTOFF VALVE	TERMINAL STRIP 261	BK	ESCM - BATT (-)
A220-T262	GAS SHUTOFF VALVE	TERMINAL STRIP 262	CU	ESCM - BATT (-)
C251-T211	EMERGENCY STOP PUSH BUTTON (EMTB)	TERMINAL STRIP 211	BK	ESCM - 14
C252-ECS1	EMERGENCY STOP PUSH BUTTON (RCP)	ECS-1	BK	ESPB - 3
C253-ESPB4	EMERGENCY STOP PUSH BUTTON (RCP)	ESPB-4	BK	ESCM - 14
C267-T158	CUSTOMER REMOTE SHUTDOWN	TERMINAL STRIP 158	BK	ESCM - 13
C268-T201	REMOTE START/STOP INITIATE CONTACT	TERMINAL STRIP 201	BK	ESCM - 9
C270-T159	GOV SYNC MOTOR SWITCH	TERMINAL STRIP 159	BK	ESCM - 22
C280-T215	DIAGNOSTIC RESET	TERMINAL STRIP 215	BK	DIAGNOSTIC RESET 2
C281-T154	BATTERY (-)	TERMINAL STRIP 154	BK	DIAGNOSTIC RESET 1
C290-T216	LAMP TEST SWITCH	TERMINAL STRIP 216	BK	ESCM - 8
C860-GOV-5		ESCM-17	BK	SPEED CONTROL 5
C861-GOV-2		ESCM-16	RD	SPEED CONTROL 2
C866-T178	RUN RELAY (N.C.)	TERMINAL STRIP 178	BK	ESCM - G
C866-T177	RUN RELAY (N.C.)	TERMINAL STRIP 177	WH	ESCM - 19
C875-T174	RUN RELAY (N.O.)	TERMINAL STRIP 174	BK	ESCM - 20
D078-T263	DDT DATA LINK	TERMINAL STRIP 263	RD	DDTC-D
D078-T264	DDT DATA LINK	TERMINAL STRIP 264	BK	DDTC-E
D078-T265	DDT DATA LINK	TERMINAL STRIP 265	CU	UNTERMINATED
D240-ESCM1		SHIELD BRAID TERMINATION	GN/YL	ESCM - 1
D240-T162	CUSTOMER INTERFACE MODULE, DATA	TERMINAL STRIP 162	RD	ESCM - 6
D240-T163	CUSTOMER INTERFACE MODULE, SHIELD	TERMINAL STRIP 163	CU	ESCM - 2
D970-T251	OIL PRESSURE/WATER TEMPERATURE	TERMINAL STRIP 251	WH	ESCM - 5
D970-T252	OIL PRESSURE/WATER TEMPERATURE	TERMINAL STRIP 252	RD	ESCM - 4
D970-T253	OIL PRESSURE/WATER TEMPERATURE	TERMINAL STRIP 253	BK	ESCM - 3
D970-T254	OIL PRESSURE/WATER TEMPERATURE	TERMINAL STRIP 254	CU	ESCM - 3
J420-T256	EIS SHUTDOWN RELAY	TERMINAL STRIP 256	BK	ESCM - 15
J430-T212	WARNING LAMP	TERMINAL STRIP 212	BK	WARNING INDICATOR (-)
J440-T213	SHUTDOWN LAMP	TERMINAL STRIP 213	BK	SHUTDOWN INDICATOR (-)
M200-T255	ESCM SHUTDOWN	TERMINAL STRIP 255	BK	ESCM - 24
M281-T173	ENFR	TERMINAL STRIP 173	BK	ESCM - 18
P220-T209	STARTER MOTOR MAGNETIC SWITCH	TERMINAL STRIP 209	RD	ESCM - 25
P221-ESCM-T		ESCM-BATT (-)	BK	ESCM - T
P280-T001	BATTERY (+)	TERMINAL STRIP 001	RD	ESCM - BATT+
P288-ECS-6		ECS-6	RD	ESCM - BATT+
P320-ECS-1		ECS-1	BK	ESCM - BATT-
P360-T153	BATTERY (-)	TERMINAL STRIP 153	BK	DDTC-B
P370-T005	BATTERY (-)	TERMINAL STRIP 005	BK	ESCM - BATT (-)
P380-T005	BATTERY (-)	TERMINAL STRIP 005	BK	TERMINAL STRIP 151
P389-T152	BATTERY (-)	TERMINAL STRIP 152	BK	POWER INDICATOR (-)
P620-T103	BATTERY (+)	TERMINAL STRIP 103	RD	ESCM - F
P620-T104	BATTERY (+)	TERMINAL STRIP 104	RD	DDTC - A
P622-ECS-5		ECS-5	BK	ESCM - 10
P623-ECS-2		ECS-2	BK	ESCM - 12
P624-ECS-3		ECS-3	BK	ESCM - 11
P625-ECS-4		ECS-4	BK	ESCM - 9
P628-T208	OFF/RESET INDICATOR	TERMINAL STRIP 208	RD	ECS - 7
P650-T160	CUSTOMER INTERFACE MODULE, PWR+	TERMINAL STRIP 160	RD	T102-(BATT+)
P650-T161	CUSTOMER INTERFACE MODULE, PWR-	TERMINAL STRIP 161	BK	T156-(BATT-)
P672-MT(+)		POWER INDICATOR +	RD	SHUTDOWN INDICATOR (+)
P673-MT(+)		SHUTDOWN INDICATOR +	RD	WARNING INDICATOR (+)
P677-T105	BATTERY (+)	TERMINAL STRIP 105	RD	POWER INDICATOR (+)
P680-T107	BATTERY (+)	TERMINAL STRIP 107	RD	ECS - 9
P684-ECS-9		ECS-10	RD	ECS - 9
P685-ECS-10		ECS-8	RD	ECS - 10
P780-T101	BATTERY CHARGER	TERMINAL STRIP 101	RD	ESCM - 26
S271-T205	MAGNETIC PICKUP ESCM	TERMINAL STRIP 205	RD	ESCM - 7
S271-T206	MAGNETIC PICKUP ESCM	TERMINAL STRIP 206	BK	ESCM - 1 (BATT-)
S271-T207	MAGNETIC PICKUP ESCM	TERMINAL STRIP 207	CU	ESCM - 1 (BATT-)

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EIS CONTROL PANEL WOODWARD GOV HARNESS				
CIRCUIT IDENT	DESCRIPTION	TERMINATION	COLOR IDENT	TERMINATION
C876-T257	2301 REMOTE SPEED TRIM	TERMINAL STRIP 257	RD	SPEED CONTROL 12
C876-T258	2301 REMOTE SPEED TRIM	TERMINAL STRIP 258	BK	SPEED CONTROL 11
C876-T259	2301 REMOTE SPEED TRIM	TERMINAL STRIP 259	GN/YL	SPEED CONTROL 1
A330-T203	GOV ACT/GOV SYNC MOTOR	TERMINAL STRIP 203	RD	SPEED CONTROL 9
A330-T204	GOV ACT/GOV SYNC MOTOR	TERMINAL STRIP 204	BK	SPEED CONTROL 10
A330-T205	GOV ACT/GOV SYNC MOTOR	TERMINAL STRIP 205	CU	SPEED CONTROL 1
P230-GOV-2	SPEED CONTROL POWER	SPEED CONTROL 2	RD	CB4-OUT
P330-T155	BATTERY (-)	TERMINAL STRIP 155	BK	SPEED CONTROL 1
P688-T106	BATTERY (+)	TERMINAL STRIP 106	RD	CB4-IN
S270-T205	MAGNETIC PICKUP 2301 GOV	TERMINAL STRIP 205	RD	SPEED CONTROL 8
S270-T206	MAGNETIC PICKUP 2301 GOV	TERMINAL STRIP 206	BK	SPEED CONTROL 7
S270-T207	MAGNETIC PICKUP 2301 GOV	TERMINAL STRIP 207	CU	UNCONNECTED

ENGINE WIRING SYSTEM

DESCRIPTION

1. Technical Field

The present invention relates generally to a wiring system for use with an engine and/or power module having a number of electrical systems, each electrical system including a number of electrical devices, and more particularly to a wiring system in which the electrical connectors connected between the electrical devices are marked with indicating or identifying indicia.

2. Background Art

Electrical connectors having indicating or identifying indicia are generally known in the art as evidenced by U.S. Pat. Nos. 2,592,788; 3,474,559; 3,551,542; 3,569,913; and 5,187,887, all of which deal with different wire marking apparatus.

Typically, the electrical connectors or wires are marked with indicia in order to identify the particular wire with reference to a circuit diagram. For example, it is known to provide alpha-numeric characters representing the particular electrical system with which the wire is associated.

It is also known to color code the electrical connectors to correspond with the proper connection in a connection junction or terminal plate to assist the user in making the electrical connection. See for example, U.S. Pat. No. 2,546,854 and GB 2,233,165. However, complex electrical circuits having a number of different electrical systems simply require too many electrical connectors for color coding to be effective. Instead, color coding is used only to convey the proper wire connections in simple electrical circuits or to identify broad circuit functions such as the wire being positive or negative. As a result, complex circuit diagrams are still relied on for the installation and repair of engines and/or power modules, such as diesel powered electrical generator sets. Prior art engines or power modules have typically marked the electrical connector or wire with an alpha-numeric designation in order to locate the particular wire in the circuit diagram. By following the path of the wire as diagrammatically represented in the circuit diagram, the various electrical connections can then be determined for the wire. However, as engine and power module electrical circuits become increasingly complex and the number of electrical connectors increases, the task of locating the particular electrical connector in the circuit diagram as well as the task of tracing the particular electrical connector between electrical devices becomes increasingly difficult and time-consuming, both in the initial wiring of the electrical system and in the diagnostics during servicing of the electrical system. What is needed is an engine or power module wiring system in which the electrical connections for the electrical connector can be readily determined without reference to a circuit diagram.

DISCLOSURE OF THE INVENTION

According to one embodiment of the present invention, a wiring system is disclosed for use with an engine or power module having a number of electrical systems, the wiring system comprising a first electrical device of an electrical system, a second electrical device of the electrical system, and an electrical connector connected between the first and the second electrical devices to define an electrical circuit, the electrical connector including first indicia identifying the electrical circuit, the first indicia including a first indicium

corresponding to the electrical system, a second indicium corresponding to the first electrical device and a third indicium corresponding to the second electrical device.

According to another embodiment of the present invention, a wiring system for use with an engine or power module is disclosed having a number of electrical systems, the wiring system comprising a first electrical device of an electrical system, a second electrical device of the electrical system, a connection junction of the electrical system, the connection junction including a connection terminal corresponding to the first and the second electrical devices, and a first electrical connector connected between the first electrical device and the connection terminal and a second electrical connector connected between the connection terminal and the second electrical device to define an electrical circuit, the first electrical connector and the second electrical connector each including first indicia identifying the electrical circuit and second indicia identifying the connection terminal.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a portion of a wiring schematic of an engine or power module having a number of electrical systems, each electrical system further having a number of electrical devices, according to one embodiment of the present invention.

FIG. **2** is a partial cross-sectional view of an electrical connector for connecting between electrical devices of FIG. **1**.

FIG. **3** is a partial cross-sectional view of an alternate electrical connector for connecting between electrical devices of FIG. **1**.

FIG. **4** depicts various look-up tables for use with the electrical connectors of FIGS. **1** and **2**.

FIG. **5** is a representative listing of alternate identifying indicia for the electrical connectors of FIGS. **2** and **3**.

BEST MODE FOR CARRYING OUT THE INVENTION

Referring now to FIG. **1**, a portion of a wiring diagram **20** for an engine and/or power module is shown. The engine or power module of the preferred embodiment, although not shown, is an engine driven generator set. However, other engine or power modules having a complex wiring scheme will also benefit from the present invention. Wiring diagram **20** depicts generally the electrical connections between various electrical devices common to an engine driven generator set. For example, electrical device **22** is a water level switch, electrical device **24** is a gas shut off valve, electrical device **26** is a low water temperature switch, electrical device **28** is a governor magnetic pickup, electrical device **30** is a governor actuator/governor synchronous motor and electrical device **32** is a tachometer magnetic pickup. The particular function of electrical devices **22**, **24**, **26**, **28**, **30** and **32** is not critical, except in that they represent one of many such devices which together define an electrical system.

For example, devices **22** and **26** are switching devices of an electrical contactor or switching system. Similarly, devices **24** and **30** are actuating devices of an electrical actuating system, and devices **28** and **32** are sensing devices of an electrical sensing system. Other systems and their respective devices contemplated by the present invention include, but are not limited to; an ignition system having a

spark plug, magneto, electronic ignition, and overspeed and magnetic switches; a power system having an alternator, battery, conditioned power, battery charger and ammeter; and a datalink system having an electronic ignition control, timing control, status control, engine control, DDTC (digital diagnostic tool connector)/display module, terminal box and a control panel.

In FIG. **1**, like connectors **34** and like connectors **36** extend between and electrically connect the various electrical devices **22**, **24**, **26**, **28**, **30** and **32** to other electrical devices such as connection junction **38**, in this embodiment a terminal strip, and connection junction **40**, in this embodiment a remote control panel providing customer connection. The various connectors **34** differ only by wire specifications such as gauge, length, color, and marking indicia. The various connectors **36** similarly differ only by wire specifications such as gauge, length, color, and marking indicia, and further by the number of connectors per cable.

Referring now to FIGS. **2** and **3**, connectors **34** and **36** are shown in greater detail. Connector **34** utilizes a typical wire construction known in the art in that a stranded or solid single conductor wire core **42** is attached to electrical terminals **44** at each end and is insulated by a plastic jacket or shielding **46**. In the specific preferred embodiment shown, connector **34** is constructed of **16** gauge stranded core wire.

In FIG. **3**, connector **36** is a multi-conductor including two connector elements **48** and a shield drain wire **49** bundled within a shielded cable **56**. In this case, the two connector elements **48** and a shield drain wire **49** include like wire cores **50** insulated by plastic jacket or shielding **52**. Similar to connectors **34**, terminals **54** are provided at the ends of connector elements **48** and shield drain wire **49**. The further shielding **56** contains and protects the connector elements and shield drain wire and terminates at a copper shield **58**. The terminal ends of shielding **56** and copper shield **58** are further enclosed by protective tubing **60**.

Referring back also to FIG. **2**, connectors **34** and **36** include an identification marker **62** and **64**, respectively, for identifying their respective electrical circuits. For example, the identification marker **62** of connector **34** has two four character alpha-numeric indicia **63** and **65** printed thereon to identify the electrical devices and system of the electrical circuit containing connector **34**, as well as the connection junction or terminal strip number of the connection junction interposed between the electrical devices. In this specific embodiment, identification marker **62** is integral with jacket **46**, and the alpha-numeric indicia "J430-T212" is printed directly onto jacket **46** and repeated along the length of connector **34**.

Conversely, identification marker **64** of connector **36** has a single four-character alpha-numeric indicia **67** printed thereon and repeated along the length of connector **36** to identify the electrical devices and system of the electrical circuit containing connector **36**. Additional markers **73** identify the connection junction or terminal strip number of the connection junction interposed between the electrical devices; however, markers **73** are not repeated along the length of connector **36** but rather are only repeated at the terminal ends. In this specific embodiment, identification markers **64** and **73** are separate plastic markers heat shrunk onto jacket **56** and elements **48** and **49**, respectively. The first alpha-numeric indicia "A220" is printed onto the heat-shrunk marker **64**, and the second alpha-numeric indicia "T260", "T261" and "T262" are printed onto the heat-shrunk markers **73**.

Unlike prior art identification indicia which correspond only generally to the electrical system that includes the particular connector and which require a separate wiring schematic, the present invention provides an electrical connector that includes an identification marker having indicia which set forth not only the electrical system containing the connector, but also the particular electrical devices connected by the electrical connector.

Referring to connector **34** in FIG. **2**, the first alpha-numeric character "**J**" of first indicia **63** corresponds to the particular electrical system including connector **34**. The second alpha-numeric character "**4**" of first indicia **63** corresponds to the electrical device connected at one end of connector **34**. The third alpha-numeric character "**3**" of first indicia **63** corresponds to the electrical device connected at the other end of connector **34**. The fourth alpha-numeric character "**0**" of first indicia **63** distinguishes between otherwise like-identified electrical devices. The fourth alpha-numeric character can correspond to a distinguishing numerical identification of the otherwise like-identified electrical devices or can correspond to a distinguishing function of the otherwise like-identified electrical devices. Additionally, the indicia "T212" identifies the connection junction or terminal strip number of the one or more connection junctions interposed between electrical devices.

Referring now to FIG. **4**, the particular electrical system of connector **34** and the particular electrical devices connected at the ends of connector **34** are determined by reference to an alpha-numeric look-up table arranged in matrix form. Within look-up table **68** are three columns **69**, **70**, and **71** which correspond to the electrical device connected at one end of connector **34**, the electrical device connected at the other end of connector **34**, and distinguishing characteristics between otherwise like-identified electrical devices, respectively.

For the connector shown in FIG. **2** bearing the indicia "J430-T212", the first alpha-numeric character "J" of first indicia **63** corresponds to the ignition system as represented by look-up table **68**. The second alpha-numeric character "**4**" corresponds to the electronic ignition as represented in column **69** of look-up table **68**. The third alpha-numeric character "**3**" corresponds to an alarm indicator as represented in column **70** of look-up table **68**. The fourth alpha-numeric character "**0**" corresponds to the particular alarm indicator among other like alarm indicators as represented in column **71** of look-up table **68**. The specific alpha-numeric characters "T212" of second indicia **65** identify the electrical connection along terminal strip **38** to which connector **34** is electrically connected. As such, the electrical circuit for a connector **34** bearing the alpha-numeric indicia "J430-T212" is established even though the electrical devices are separated by terminal strips.

Similar look-up tables **72**, **74**, **76** and **78** are also shown in FIG. **4** and which represent other electrical systems corresponding to the first alpha-numerical character of first indicia **63**. For example in look-up table **72**, the alpha-numeric character "P" corresponds to the power system. In look-up table **74**, the alpha-numeric character "D" corresponds to the data link system. In look-up table **76**, the alpha-numeric character "M" corresponds to the module system. In look-up table **78**, the alpha-numeric character "A" corresponds to the actuator system. Within each of the look-up tables **68**, **72**, **74**, **76** and **78**, the second alpha-numeric character represents a first electrical device (e.g., "source **1**", "source", "1st module" and "source of control"), the third alpha-numeric character represents a second electrical device (e.g., "source **2**", "destination", "2nd module" and "controlled parameter"), and the fourth alpha-numeric

character distinguishes between connectors electrically connected between like electrical devices.

As another example, for the connector shown in FIG. **3** bearing the indicia "A220", the first alpha-numeric character "A" of indicia **67** corresponds to the electrical actuator system as represented by look-up table **78**. The second alpha-numeric character "**2**" of indicia **67** corresponds to the status control device as represented in column **79** of look-up table **78**. The third alpha-numeric character "**2**" of indicia **67** corresponds to the fuel shut-off device (i.e., gas shut off valve) as represented in column **80** of look-up table **78**. The fourth alpha-numeric character "**0**" of indicia **67** corresponds to the particular fuel shut-off device (device no. **1**) and distinguishes that device from a number of like fuel shut-off devices.

Additionally, the indicia "T260", "T261" and "T262" identify the connection junctions or terminal strip numbers of the one or more connection junctions interposed between electrical devices. In this specific embodiment, the specific alpha-numeric characters "T260", "T261" and "T262" of indicia **73** identify the electrical connections along terminal strips **38** and **40** to which connector **36** is electrically connected. As such, the electrical circuit for a connector **36** bearing the alpha-numeric indicia "A220-T262" is established even though the electrical devices are separated by terminal strips.

Referring now to FIG. **5**, other alpha-numeric indicia for use with connectors **34** and **36** of circuit diagram **20** are shown. For example, table **78** lists the various connectors associated with the EIS remote control panel, (e.g. A220-T260, A220-T261. . . S271-T206, and S271-T207) while table **80** lists the various connectors associated with the EIS panel for a governor harness (e.g., C876-T257, C876-T258. . . S270-T206 and S270-T207). In each instance, the circuit connections for the connector are fully described by the first and second alpha-numeric indicia without resort to a separate and complex wiring diagram.

The benefits of the present engine wiring system are apparent when considering a wiring schematic having a thousand or more separate electrical connectors. The present system is easily adapted to even more complex systems simply by expanding the number of look-up tables or the number of electrical devices within the look-up tables. For example, ten electrical systems corresponding to ten look-up tables with each look-up table having ten electrical devices per column would fully describe 10,000 different electrical connectors.

Other benefits include time-saving diagnostics. For example, by repeating the identification marker continually along the length of the electrical connector, an open circuit is easily diagnosed and repaired. By merely locating the broken wire, the identification marker is readily located and the circuit known without reference to a wiring diagram. After locating a broken wire, the source, destination and function of the broken wire are easily determined merely by referring to the proper look-up table, rather than by searching through a lengthy and complex wiring schematic. As such, the broken wire immediately conveys the effect the break has on overall system operation and, based on the effect, the immediacy of the required repair.

The present invention can also be adapted for use with computer based diagnostics. For example, the connectors can be marked with computer readable indicia, for example optical bar codes. A bar code reading device can read the bar code directly into computer memory where it can be electronically compared with look-up tables that are also in computer memory. The electrical system and device connections for the connector can then be displayed for rapid installation and/or diagnostics. Further, additional information in computer memory associated with the electrical circuit can be displayed for diagnostics, such as the effect a broken wire has on system operation and the immediacy of the required repair; i.e., whether to immediately perform a costly system shut-down or wait to perform the repair during scheduled maintenance.

We claim:

1. A wiring system for use with an engine or power module having a number of electrical systems, the wiring system comprising:

a first electrical device of an electrical system;

a second electrical device of said electrical system; and

an electrical connector connected between said first and said second electrical devices to define an electrical circuit, said electrical connector including first indicia identifying said electrical circuit;

said first indicia including a first indicium corresponding to said electrical system, a second indicium corresponding to said first electrical device and a third indicium corresponding to said second electrical device.

2. The wiring system of claim **1**, wherein said first indicia are alpha-numeric indicia identifying said electrical circuit, said alpha-numeric indicia including a first alpha-numeric indicium corresponding to said electrical system, a second alpha-numeric indicium corresponding to said first electrical device and a third alpha-numeric indicium corresponding to said second electrical device.

3. The wiring system of claim **2**, and further comprising:

a third electrical device of said electrical system, said third electrical device being substantially the same as said second electrical device;

wherein said first alpha-numeric indicia includes a fourth alpha-numeric indicium distinguishing said second electrical device from said third electrical device.

4. The wiring system of claim **2**, wherein said first alpha-numeric indicia are repeated along the length of said electrical connector.

5. The wiring system of claim **2**, wherein said electrical connector further comprises:

a wire core having a terminal at each end;

an insulative jacket extending between said terminals and surrounding said wire core; and

an identification marker attached to said insulative jacket, said identification marker having said first alpha-numeric indicia printed thereon.

6. The wiring system of claim **5**, wherein said identification marker is integral with said insulative jacket and said first alpha-numeric indicia is printed on said insulative jacket.

7. The wiring system of claim **5**, wherein said identification marker is constructed of plastic and heat-shrunk onto said insulative jacket.

8. The wiring system of claim **2**, wherein one of said electrical devices is a connection junction including a terminal and said electrical connector includes second alpha-numeric indicia identifying said terminal.

9. The wiring system of claim **8**, wherein said second alpha-numeric indicia are disposed adjacent to said first alpha-numeric indicia.

10. The wiring system of claim **8**, wherein said electrical connector further comprises:

a number of connector elements, each of said connector

elements including a wire core having a terminal at each end and a first insulative jacket extending between said terminals and surrounding said wire core;

a second insulative jacket surrounding said number of connector elements and extending to near said terminals;

each of said connector elements further including a first identification marker attached to said first insulative jacket and exposed between said second insulative jacket and said terminal, said first identification marker having said second alpha-numeric indicia printed thereon; and

a second identification marker attached to said second insulative jacket, said second identification marker having said first alpha-numeric indicia printed thereon.

11. A wiring system for use with an engine or power module having a number of electrical systems, the wiring system comprising:

a first electrical device of an electrical system;

a second electrical device of said electrical system;

a connection junction of said electrical system, said connection junction including a connection terminal corresponding to said first and said second electrical devices; and

a first electrical connector connected between said first electrical device and said connection terminal and a second electrical connector connected between said connection terminal and said second electrical device to define an electrical circuit;

said first electrical connector and said second electrical connector each including first indicia identifying said electrical circuit and second indicia identifying said connection terminal.

12. The wiring system of claim **11**, wherein said first indicia are alpha-numeric indicia including a first alpha-numeric indicium corresponding to said electrical system, a second alpha-numeric indicium corresponding to said first electrical device and a third alpha-numeric indicium corresponding to said second electrical device.

13. The wiring system of claim **12**, and further comprising:

a third electrical device of said electrical system, said third electrical device being substantially the same as said second electrical device;

wherein said first alpha-numeric indicia includes a fourth alpha-numeric indicium distinguishing said second electrical device from said third electrical device.

14. The wiring system of claim **11**, wherein said connection terminal includes alpha-numeric indicia identifying said connection terminal and said second alpha-numeric indicia corresponds to said alpha-numeric indicia identifying said connection terminal.

15. The wiring system of claim **14**, wherein said second alpha-numeric indicia are disposed adjacent to said first alpha-numeric indicia.

16. The wiring system of claim **15**, wherein said first and said second alpha-numeric indicia are repeated along the lengths of each of said first and said second electrical connectors.

17. The wiring system of claim **11**, wherein each of said first and said second electrical connectors further comprises:

a wire core having a terminal at each end;

an insulative jacket extending between said terminals and surrounding said wire core; and

an identification marker attached to said insulative jacket, said identification marker having said first and said second alpha-numeric indicia printed thereon.

18. The wiring system of claim **17**, wherein said identification marker is integral with said insulative jacket and said first alpha-numeric indicia is printed on said insulative jacket.

19. The wiring system of claim **17**, wherein said identification marker is constructed of plastic and heat-shrunk onto said insulative jacket.

20. The wiring system of claim **11**, wherein said electrical connector further comprises:

a number of connector elements, each of said connector elements including a wire core having a terminal at each end and a first insulative jacket extending between said terminals and surrounding said wire core;

a second insulative jacket surrounding said number of connector elements and extending to near said terminals;

each of said connector elements further including a first identification marker attached to said first insulative jacket and exposed between said second insulative jacket and said terminal, said first identification marker having said second alpha-numeric indicia printed thereon; and

a second identification marker attached to said second insulative jacket, said second identification marker having said first alpha-numeric indicia printed thereon.

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